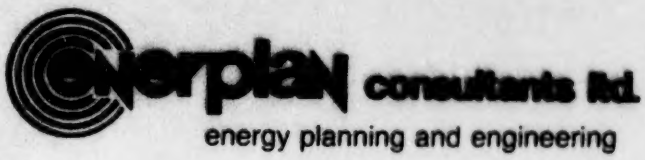

ARENA ENERGY EFFICIENT RETROFITS

REPORT COMPILED BY
ENERPLAN CONSULTANTS LTD.
MONCTON, N.B.

1984

86 Botsford Street, Moncton, N.B. E1C 4X3 • (506) 854-5536

D I S C L A I M E R

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D E N I D E R E S P O N S A B I L I T E

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The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

Conservation & Renewable
Energy Division
Energy Secretariat
P.O. Box 6000
Fredericton, N.B.
E3B 5H1
(506) 453-3897

Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

Division des économies d'énergie
et des énergies renouvelables
Secrétariat à l'énergie
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Energy, Mines and Resources Canada | Energie, Mines et Ressources Canada

New Brunswick Energy Secretariat

Arena Retrofits

Enerplan Consultants Ltd.

Project Summary

Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

Project Location:
Riverview - Albert Co.
Saint-Leonard, Madawaska Co.
Lamèque, Gloucester Co.

Project Manager:
Kirk A. Bavis, P.Eng.
Enerplan Consultants Ltd.
188 Gordon St. Moncton, N.B.
Telephone: (506) 854-5536

Date:
July, 1982

Project Number:
2027

Status:
Initiated
Expected Completion: 1983

Technology:
Conservation - Heat Recovery
- Space Heating

Sector:
Public - Municipal

Province:
New Brunswick

Purpose:

To demonstrate how energy conservation techniques can successfully be applied to New Brunswick arenas or skating rinks. To develop an energy retrofit package for New Brunswick arenas.

Description:

Initially, metering and monitoring equipment will be installed at the three sites in order to obtain accurate energy consumption records for the 1981-1982 skating season. Subsequently, heat recovery equipment will be installed and the heat which is now being wasted will be utilized to heat the water used in ice-making and space heating. Modifications to the lighting systems will also be implemented. (e.g. Extant Mercury Vapour to Metal Halide and HPS.) Also an automatic light dimming system will be installed.

Contributors:

Three Municipalities: $ 45,000
Canada/New Brunswick: $137,675

Expected Benefits/Savings:

These should be in the vicinity of $7,000 to $10,000 per year, since the operating cost of each arena runs from $30,000 to $45,000 per year. This translates to a percentage savings of approximately 25% per year.

Further Information:

Upon completion of the installation of the retrofit items, each site will be visited on a monthly basis for a full 12 months. All of the information obtained on the 3 projects will be properly analyzed and evaluated and the results will be tabulated in a final report. Also, a slide presentation will be prepared and presented to various community groups associated with arenas throughout New Brunswick. Finally, a bilingual brochure will be prepared.

Information Contact:

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OR

Maurice Robichaud
Energy Secretariat
P.O. Box 6000
Fredericton, N.B. E3B 5H1

Telephone: (506) 453-3897

Project Title:

Arena Retrofits - Enerplan Consultants

Economic Analysis:

Project Costs -

Capital Equipment & Installation	$170,675
Monitoring & Information Transfer	$ 12,100
Total Demonstration Costs	$182,675

Energy Impact -4,000 gallons of fuel oil ($4,240) and 420,000 kWh ($23,100) will be conserved by the implementation of improved lighting fixtures and the installation of heat recovery equipment resulting in a total annual saving of $27,000 and a payback of 6 years.

Monitoring/Evaluation:

Extensive monitoring will be performed at each site both before and after the retrofit. This will allow very precise performance evaluations of the systems and subsystems involved. Some of the meter types used will be:

i) kWh meter (lighting)
ii) Hour meter (Refrigeration)
iii) Water usage meters (Hot water)
iv) Temperature Meters (inside & outside)
v) Brine temperature recorders.

Technical Details/Specifications:

Since all equipment has yet to be installed it is impossible to include technical details at this time. However, comprehensive technical data will be available by the summer of 1983.

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1.0 EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

A detailed analysis of the results of the energy demonstration project on three arenas reveals that the application of heat reclaim equipment and high-intensity discharge lighting is technically feasible and acceptable. The economic feasibility is dependent entirely on the annual hours of utilization of the facility and the population being served. Simple paybacks range from two to nine years and each individual arena must be studied to determine the economic feasibility.

The application of high-pressure sodium lighting over the ice surface has been well accepted and has successfully reduced power consumption. The heat reclaim systems have operated well and have effectively reduced energy costs.

We have no difficulty in recommending high-pressure sodium lighting and heat reclaim, however, the economic return on the investment must be carefully studied before implementation.

1.0 RESUME

Une analyse détaillée des résultats enregistrés relativement au projet de démonstration des économies d'énergie portant sur trois centres sportifs, revèle que l'utilisation d'un matériel de récupération de chaleur et d'un système d'éclairage à décharge et à haute intensité est techniquement faisable et acceptable. La faisabilité économique est entièrement fonction du nombre d'heures annuel d'utilisation des installations et de l'importance de la population desservie. Les périodes de récupération varient de deux à neuf années. Chaque centre doit être étudié individuellement pour en déterminer la faisabilité économique.

L'utilisation d'un éclairage à vapeur de sodium à haute pression au-dessus de l'aire de glace a reçu un bon accueil et s'est avérée efficace pour réduire la consommation d'énergie. Les systèmes de récupération de chaleur ont fonctionné efficacement et ont permis de réduire les coûts énergétiques.

Nous recommandons sans réserve l'éclairage à vapeur de sodium à haute pression ainsi que les systèmes de récupération de chaleur. Toutefois, le taux de rendement du capital investi doit être étudié minutieusement avant de procéder à la mise en place de tels systèmes.

2.0 INTRODUCTION

2.0 INTRODUCTION

2.1 General

The Province of New Brunswick has a population of approximately 800,000 and has 84 artificial ice arenas. The cost of operating an arena has been on the rise and is now becoming a financial burden on many communities.

Enerplan Consultants Ltd. prepared and submitted a proposal for an energy demonstration project on three typical community arenas in the Province of New Brunswick in May of 1981. The primary objective of the proposal was to demonstrate feasible methods of reducing operating costs of ice arenas. The proposal was accepted by the Energy Secretariat for funding under the Conservation and Renewable Energy Development Agreement and was initiated on August 12, 1981.

The initial phase of the project consisted of installing metering equipment in three arenas and monitor the energy consumption of the various components for the 1981-82 season. Upon completion of the energy monitoring, design of retrofit items was completed and construction initiated during the summer of 1982. Monitoring was then undertaken for the 1982-83 season and the project was then completed with comparisons of the before and after retrofit situations.

2.0 INTRODUCTION

2.2 Site Selection

With eighty-four arenas to choose from, the selection process was quite difficult. The criteria used for selection are listed below:

(1) geographical location
(2) population of the community
(3) type of fuels consumed
(4) existing arena operation
(5) funding by community

The sites selected, i.e., St. Leonard, Madawaska County; Lameque, Gloucester County; and Riverview, Albert County;, represent a good cross-section of arenas in the Province of New Brunswick and are typical of most. St. Leonard Arena (Palais des Sports) is owned and operated by the Town; is oil-fired; and serves a population of approximately 1500 residents. Lameque Arena is owned and operated by a private commission with a subsidy from the Village; is all electric; and serves a population of approximately 1200 residents. Riverview Arena is owned and operated by the Town; is all-electric; and serves a population of approximately 15,000 residents.

3.0 TECHNICAL DESCRIPTION

3.0 TECHNICAL DESCRIPTION

3.1 General

The energy consumption in an arena can be divided among four major items:

1. Refrigeration equipment
2. Lighting
3. Heating of water for ice re-surfacing
4. Space heating

It was decided to aim our demonstration project at these items and determine the feasibility of energy retrofit.

Upon completion of metering and monitoring all energy inputs for the 1981/82 season, it was concluded that demonstrations in heat reclaim and new lighting would provide the best energy savings.

3.2 Heat Reclaim

The refrigeration plant in an arena consists of compressor(s), a condensor, brine chiller and associated pumps, controls, etc. A schematic of a typical system is illustrated in Appendix C.

3.0 TECHNICAL DESCRIPTION

3.2 Heat Reclaim (Cont'd)

The refrigerant gas, ammonia in this case, is compressed to higher temperatures and pressures by the compressor(s) and is then directed to the condensor, which is normally located outside, where it releases its heat and is condensed to a liquid. The cooled liquid ammonia is then circulated through the brine chiller where it absorbs heat from the brine and, once again, returns to a gas which enters the compressor, and the cycle is repeated.

The heat which is rejected to the condenser can be partially reclaimed and utilized for heating water or for space heating. A heat exchanger is installed in the refrigerant gas line, as illustrated in Appendix C and the superheat removed. Water or glycol is circulated through one side of the heat exchanger and refrigerant gas through the other side.

3.3 Heat Reclaim Retrofits

3.3.1 Byron Dobson Memorial Arena - Riverview, N.B.

The arena was constructed in 1970 and is typical of other arenas in New Brunswick. It is a pre-engineered metal structure with minimal insulation and is all-electric. The refrigeration plant, which has been upgraded since 1970, now has 2 new 40 HP ammonia compressors, the original evaporative condensor, brine chiller and pump.

3.0 TECHNICAL DESCRIPTION

3.3 Heat Reclaim Retrofits

3.3.1 Byron Dobson Memorial Arena (Cont'd)

The flood water is heated electrically via two immersion coils in a 500 gallon tank; shower water, by a 40 gallon electric hot water tank. Heat reclaim equipment was installed in August of 1982 to preheat the flood water. The equipment installed was manufactured by 'Thermostor' and consists of a storage tank with an ammonia coil within.

3.3.2 Lameque Arena - Lameque, N.B.

Lameque Arena was constructed in 1965 and is typical of a large number of arenas. It is a pre-engineered metal structure with minimal insulation and is all-electric. The refrigeration plant has a capacity of 211 KW (60 tons refrigeration) and operates from mid October to the end of March.

Space heating of dressing rooms and other areas is provided by electric unit heaters and baseboard convectors; domestic hot water and flood water is provided by three 100 gallon hot water heaters.

Heat reclaim equipment was installed in the hot gas discharge line from the compressors and utilized to preheat the domestic and flood water. The equipment installed was 'Egosaver' Model EA 004 014.

3.0 TECHNICAL DESCRIPTION

3.3.3 Palais des Sports, St Leonard, N.B.

St. Leonard arena was constructed in 1967 and is also typical of many New Brunswick arenas. The refrigeration plant has a capacity of 211 KW (60 tons refrigeration) and operates for a maximum of six months per year. Normal operating season begins in mid-October and terminates in March.

Space heating of dressing rooms and other public areas is provided by an oil-fired warm air system; domestic hot water for showers is also oil-fired; and flood water is heated by propane.

Due to the distant location of the flood water heaters, heat reclaim equipment was utilized to assist in space heating of dressing rooms, canteen and common areas. The equipment consisted of a shell and tube heat exchanger with ammonia gas on one side and a glycol solution on the other. The glycol circulates through a heating coil located in the supply air plenum of a warm air furnace.

3.4 Lighting Systems

3.4.1 Efficiency of Light Sources

Most arenas' ice surfaces are illuminated with mercury-vapor lights; such was the case with the

3.0 TECHNICAL DESCRIPTION

3.4 Lighting Systems

3.4.1 Efficiency of Light Sources (Cont'd)

three arenas in our demonstration project. Recent advances in lighting technology have produced light sources which are much more efficient than mercury vapor. Also, lighting levels have been revised downwards in the past few years.

The efficiencies of the various light sources available are illustrated in Appendix D.

3.0 TECHNICAL DESCRIPTION

3.0 TECHNICAL DESCRIPTION

3.5 Lighting System Retrofits

3.5.1 Byron Dobson Memorial Arena - Riverview, N.B.

Prior to retrofit, the Riverview Arena was equipped with fifty 750 watt mercury vapor lights with manual switching for the skating surface area. It was decided to change the mercury vapor fixtures and install high pressure sodium fixtures complete with a dimming system. The fixtures selected were WIDE-LITE 400 watt HPS and thirty (30) were installed.

3.5.2 Lameque Arena - Lameque, N.B.

The Lameque Arena was illuminated by sixty (60) 400 watt mercury vapor fixtures over the ice surface; incandescent fixtures over bleachers, in dressing rooms and common areas. The entire lighting system was retrofitted with the mercury replaced by high pressure sodium (27 @ 400 watt); and the incandescent with energy efficient fluorescent.

3.5.3 Palais des Sports - St. Leonard, N.B.

This facility was similar to Lameque except that the ice surface had fifty (50) 400 watt mercury fixtures. The retrofit contract consisted of installing twenty-seven (27) HPS fixtures and replacing all incandescents with energy efficient fluorescents.

4.0 PERFORMANCE OF SYSTEMS

4.0 PERFORMANCE OF SYSTEMS

4.1 Metering & Monitoring

The three arenas were extensively metered before and after retrofits and the data recorded on a regular schedule. The energy consumption of each arena was metered to determine the amount of energy consumed by the following items:

(a) Refrigeration plant
(b) Flood water heating
(c) Shower water heating
(d) Ice surface lighting
(e) Space heating
(f) General lighting and power

Meters were also installed to record:

(a) Total water consumption
(b) Flood water consumption
(c) DHW consumption
(d) Operating hours of compressors
(e) Operating hours of brine pump
(f) Operating hours of condensor pump and fan
(g) Consumption of fuel oil and/or propane
(h) Indoor and outdoor dry-bulb temperatures

The data was recorded by operating personnel at the arenas on a once weekly basis. Every fourth week it was recorded daily for the full week. Upon completion of the ice season, readings were taken and not repeated until start-up in the fall.

4.0 PERFORMANCE OF SYSTEMS

4.2 Technical Performance

4.2.1 General

The energy demonstration systems installed in the three arenas have performed well over the 1982-83 season. They have been well received by the users of the facilities and have accomplished their expected tasks.

4.2.2 Heat Reclaim Systems

The heat reclaim systems have performed satisfactorily and have produced savings. They have been monitored for one season only (1982-83) and appear to be equally well constructed, efficient in operation, and virtually maintenance-free.

4.2.3 Lighting Systems

The lighting systems, all of which are high pressure sodium, have performed well and have been extremely well received by all occupants of the buildings. The color rendition of the high pressure sodium lamps has not proven to be a problem, as we initially expected it would, and, in fact, has been so well accepted that various other arenas in the province are now installing HPS fixtures.

5.0 PROJECT COST ACCOUNTING

5.0 PROJECT COST ACCOUNTING

5.1 Total Project Cost & Funding

The cost breakdown for this project is listed below:

Capital Construction) Heat Reclaim) Lighting)	$139,725
Metering Equipment)	
Engineering & Management	23,150
Performance Monitoring	12,600
Information Transfer	2,500
Final Report	4,700
Project Total	$182,675
CREDA Funding	$137,675
Municipality Funding	$ 45,000
	$182,675

5.0 PROJECT COST ACCOUNTING

5.2 Detailed Cost Breakdown

Capital Construction		$140,320.94
Metering Equipment	$36,085.23	
Lighting Contract		
- Lameque	$18,413.77	
- St. Leonard	$18,955.00	
- Riverview	$25,680.00	
Heat Reclaim		
- Lameque	$12,888.00	
- St. Leonard	$14,621.14	
- Riverview	$13,677.80	
Engineering & Management		23,150.00
Performance Monitoring		12,600.00
Information Transfer		2,000.00
Final Report		4,604.06
		$182,675.00

6.0 COST BENEFIT ANALYSIS

6.0 COST BENEFIT ANALYSIS

6.1 Payback Periods

A payback period is calculated by dividing the estimated capital costs by the estimated annual savings.

Example

Modification "A" is estimated to cost $20,000 to install and will save 150,000 KWH annually.

Payback Period = $20,000/150,000 KWH x $.04/KWH
= 3.3 years

This calculation method is used commonly by business as an easy reference for economic feasibility. It does not consider interest rates or increasing costs of energy.

6.2 Heat Reclaim Systems

6.2.1 General - The cost effectiveness of a heat reclaim system is dependent on many variables and each arena application must be studied separately. Some of the variables which have impact on a heat reclaim system are listed below:

(a) Length of operating season
(b) Geographic location of facility
(c) Daily occupancy cycle of facility
(d) Quality of ice making
(e) Type and size of refrigeration plant

6.0 COST BENEFIT ANALYSIS (Cont'd)

6.2 Heat Reclaim Systems

6.2.2 Byron Dobson Memorial Arena - Riverview, N.B.

Riverview Arena

Operating Season	-	Oct 1 - Apr 15
Daily Occupancy	-	6:30 a.m. to 12:30 a.m. 7 days per week
Climatic Conditions	-	8000 degree days
Refrigeration Plant	-	75 tons refrigeration capacity

Cost-Benefit Analysis

Capital Cost of Heat Reclaim	- $13,678
Annual Savings (1982-83 season)	- $4,275
Simple Payback Period	- 3.2 years

6.0 COST BENEFIT ANALYSIS (Cont'd)

6.2.3 Palais des Sports, St. Leonard, N.B.

St. Leonard Arena

Operating Season	-	Oct 15 - Mar 31
Daily Occupancy	-	3:00 p.m. - 11:00 p.m. weekdays
		7:00 a.m. - 11:00 p.m. Sat. & Sun.
Climatic Conditions	-	9200 degree days
Refrigeration Plant	-	60 tons refrigeration

Cost Benefit Analysis

Capital Cost of Heat Reclaim	-	$14,621
Annual Savings (1982-83 Season)	-	$ 2,060
Simple Payback Period	-	7.1 years

6.0 COST BENEFIT ANALYSIS (Cont'd)

6.2.4 Lameque Arena, Lameque, N.B.

Lameque Arena

Operating Season - Oct 15 - Mar 31

Daily Occupancy - 3:00 p.m. - 11:00 p.m. Week Days
7:00 a.m. - 11:00 p.m. Sat & Sun

Climatic Conditions - 9200 degree days

Refrigeration Plant - 60 tons refrigeration

Cost Benefit Analysis

Capital Cost of Heat Reclaim - $12,888

Annual Savings (1982-83 Season) - $ 1,345

Simple Payback Period - 9.6 years

6.0 COST BENEFIT ANALYSIS

6.3 Lighting Systems

6.3.1 General - The cost effectiveness of a new lighting system is dependent on a few variables as listed below:

(a) Length of operating season and hours of usage
(b) Electric Rate Structure
(c) Type of fixtures and their efficiencies

In our case, all three arenas had mercury vapor fixtures which were replaced by high pressure sodium.

6.3.2 Riverview

Riverview Arena

Operating Season	-	Oct 1 - Apr 15
Daily Occupancy	-	6:30 a.m. to 12:30 a.m. 7 days per week
Previous Lighting on Ice Surface	-	52 mercury vapor fixtures @ 750 watts each = 39,000 watts
New System	-	27 High Pressure Sodium Fixtures @ 400 watts = 10,800 watts

Cost Benefit Analysis

Capital Cost of System without dimming	-	$15,000
Annual Savings	-	$ 5,540
Simple Payback	-	2.7 years
Capital Cost of System with dimming	-	$27,500
Annual Savings	-	$ 6,570
Simple Payback	-	4.2 years

6.0 COST BENEFIT ANALYSIS

6.3 Lighting Systems

6.3.3 St. Leonard

St. Leonard

Operating Season	-	Oct 15 - Mar 31
Daily Occupancy	-	3:00 p.m. - 11:00 p.m. weekdays 7:00 a.m. - 11:00 p.m. Sat & Sun
Previous Lighting on Ice Surface	-	50 Mercury Vapor @ 400 watts = 20,000 watts
New System	-	27 HPS @ 400 = 10,800 watts

Cost Benefit Analysis

Capital Cost of System	- $18,955.00
Annual Savings	- $ 2,195.00
Simple Payback	- 8.6 years

6.3.4 Lameque Arena

Lameque Arena

Operating Season	-	Oct 15 - Mar 31
Daily Occupancy	-	3:00 p.m. - 11:30 p.m. Weekdays 7:00 a.m. - 11:30 p.m. Sat & Sun
Previous Lighting on Ice Surface	-	60 Mercury Vapor @ 400 watts = 24,000 watts
New System	-	27 HPS @ 400 watts = 10,800 watts

Cost Benefit Analysis

Capital Cost of System	- $18,414
Annual Savings	- $ 2,600
Simple Payback	- 7.1 years

7.0 INFORMATION TRANSFER

7.0 INFORMATION TRANSFER

7.1 General

A great amount of interest was shown for this project as a result of efforts by the Energy Secretariat and the provincial Department of Youth and Recreation. Public officials and civil servants have been instrumental in dessiminating information among the various municipalities in the Maritime Provinces. Technical seminars were held in each of the three communities in May of 1983 and the response was overwhelming.

7.2 Inquiries

To date inquiries have been received or information has been provided to the owners and operators of approximately 90% of the arenas in the Province of New Brunswick. A delegation of ten people from Prince Edward Island attended the technical seminar held in Moncton, New Brunswick. The Department of Mines and Energy from the Province of Nova Scotia has expressed interest in the project and have requested further information.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The heat reclaim and lighting projects in the three arenas have been successful and have demonstrated that such retrofits are technically feasible and will produce savings in operating costs.

The three different types of heat reclaim equipment have performed well and are as advertised by their manufacturers.

The high pressure sodium lighting over the ice surface area has been proven to be acceptable in terms of color rendition and operating efficiency.

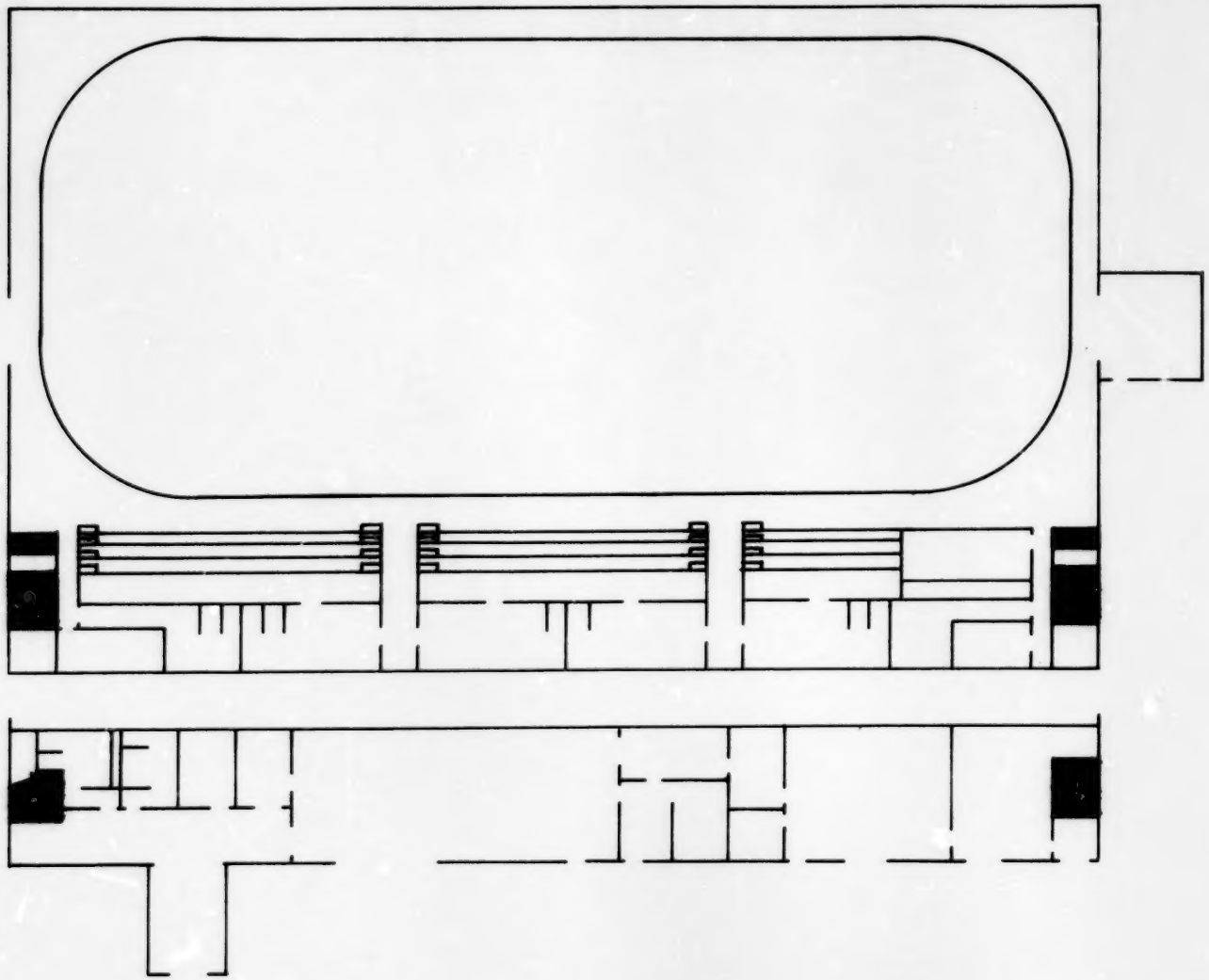
8.2 Recommendations

As a result of this demonstration project, we submit the following recommendations:

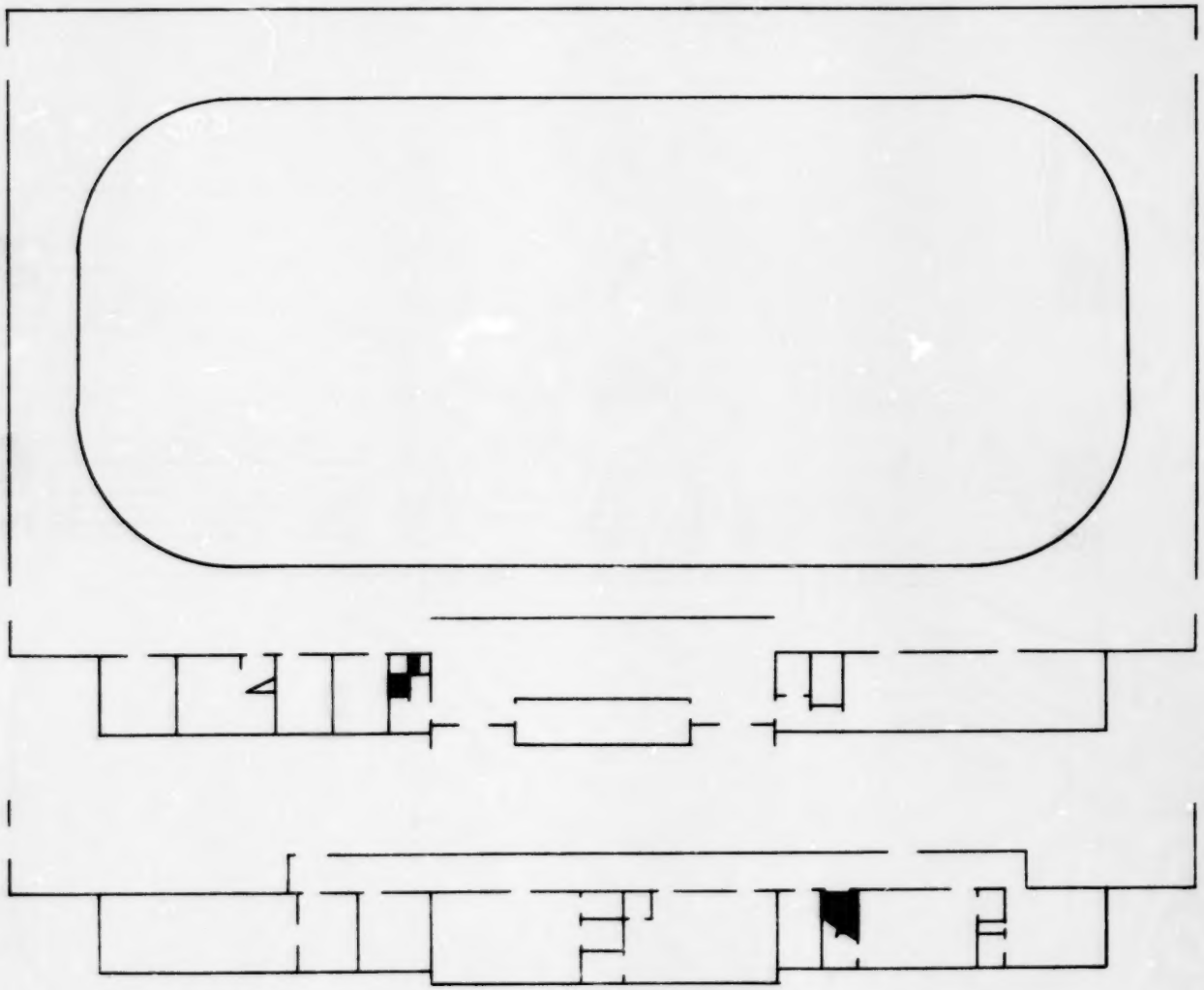
- that high pressure sodium lighting be utilized in community arenas and that the lighting levels demonstrated (50 foot candles) not be exceeded.
- that dimming not be installed for high pressure sodium lighting unless the arena is multi-purpose and heavily utilized throughout the full year.
- that heat reclaim equipment be installed to preheat domestic and flood water and not be utilized for space heating.
- that a detailed economic study be undertaken to determine the feasibility of heat reclaim or new lighting prior to commitment.

APPENDIX A

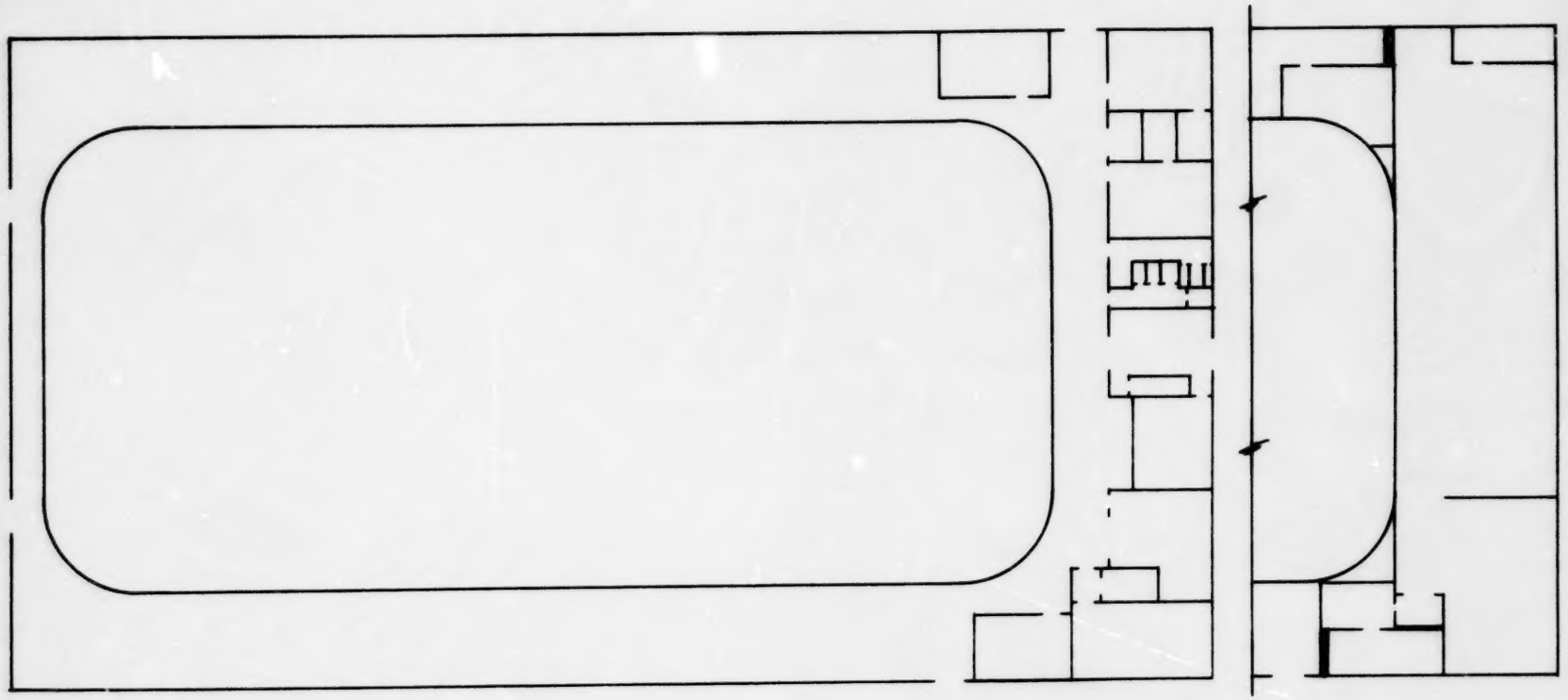
FLOOR PLANS OF ARENAS



RIVERVIEW ARENA



ST. LEONARD ARENA



LAMEQUE ARENA

APPENDIX B

MONITORING RECORDS

ARENA RIVERVIEW NB
LOCATION BIGGS DRIVE

ENERGY DEMONSTRATION PROJECT

ENERPLAN CONSULTANTS LTD.
86 BOTSFORD STREET
MONCTON, N.B.

WEEK COMMENCING 30 NOVEMBER 19 81

		MON 5 P.M	DEC. 1 TUES 4.00 PM	DEC. 2 WED 4.00 PM	DEC. 3 THUR 4.	DEC. 4 FRI 4.00 PM	SAT	SUN	N30 - N23 REMARKS
WATER METER	MAIN WATER METER	115.	25367.	0000.7	00005.8	0011.6		3.0	410 (GALLONS?) = 1.
	FLOOD WATER	20.4	5951	0002.7	000.3	0005	2	.6	893 = 3.8
	DOMESTIC HOT WATER	.7	156.°	0000.0	000.0	000.3		0.5	21 = .1
ELECTRICAL METERS (KWH) KWHR / DEMAND	ICE SURFACE LIGHTING	0372 / 260	/ 280	0284 / 290	0290 / 290	0296 / 290		0313 / 460	53 / 410
	BLEACHER HEATING	0006 / 0	0006 / 0	0006 / 0	000 / 0	0006 / 0		0007 / 0	1 / 0
	UNIT HEATERS	0282 / 470	0292 / 500	0302 / 510	0309 / 340	0316 / 320		0338 / 330	67 / 480
	DOMESTIC HOT WATER	0014 / 0	0014 / 0	0014 / 0	0014 / 0	0015 / 0		0015 / 0	2 / 20
	FLOOD WATER HTR #1	/ 300	0126 / 300	/ 320	0130 / 300	0133 / 300		0139 / 0	16 / 0
	FLOOD WATER HTR #2	0079 / 295	0081 / 300		0084 / 300	0086 / 300		0191 / 0	16 / 0
	REFRIGERATION UNIT	0375 / 0	0381 / 390	05 / 400	0594 / 400	0403 / 0		0420 / 420	47 / 390
	MISC. LOAD PANEL "C"	0210 / 40	0231 / 400	0280 / 420	0238 / 360	0245 / 340		0260 / 320	37 / + 130
	BASEBOARD HEATING	0221 / 840	0247 / 80	0266 / 790	0280 / 790	0295 / 400		0316 / 340	21 / + 820
	CANTEEN EQUIPMENT	0105 / 100	0111 / 100	0114 / 60	0116 / 90	0118 / 90		0122 / 95	16 / 0
ELAPSE TIME METERS (HOURS)	COMPRESSOR NO. 1		797.31	810.16	830.02	851.69		892.62	118.61
	COMPRESSOR NO. 2		830.95	843.89		885.67		926.69	119.08
	BRINE PUMP		830.96	843.93		885.95		926.98	114.09
	CONDENSOR FAN		787.73	807.93		899.36		879.71	96.05
	DHW CIRCULATOR		10 .54	1057.38		1105. 0		1153.27	168.3
	REFRIGERATION FAN		884.15	907.97	932.63	956.00		1003.87	169.28
	CONDENSOR PUMP		159.83	163.03	165.57	168.31		172.83	27.49
TEMPERATURES °C	OUTSIDE TEMP. °C	°c	4 °c	46 °F	44 °F	50 °F		15 °c	
	INSIDE TEMP. °C	6 °c	7 °c	10 °c	11 °c	13 °c		14 °c	
BRINE TEMPERATURE (°C)		170 F	16 °F	17 °F	16 °F	16 °F		19 °F	

ARENA LAMEQUE N.B.
LOCATION

ENERGY DEMONSTRATION PROJECT

ENERPLAN CONSULTANTS LTD.
86 BOTSFORD STREET
MONCTON, N.B.

WEEK COMMENCING 31 JANUARY 1983		MON	TUES	WED	THUR	FRI	SAT	SUN	REMARKS
WATER METER	MAIN WATER METER	1458							
	FLOOD WATER	591							
	DOMESTIC HOT WATER	1414							
ELECTRICAL METER (KWH)	ICE SURFACE LIGHTING								
	UNIT HEATERS								
	WATER HEATERS								
	REFRIGERATION UNIT								
KWH / DEMAND	MISC. LOADS								
	CANTEEN EQUIPMENT								
ELAPSE TIME METERS (HOURS)	COMP#1	1145.8							
	COMP#2								
	BRINE PUMP								
	COND. FAN								
	COND. PUMP								
	FAN 1&2								
	FAN F3 – CANTEEN	386.3							
TEMPERATURES (°C)	INSIDE °C								
	OUTSIDE °C								
BRINE TEMPERATURE (°C)									

ARENA PALAIS DES SPORTS
LOCATION ST. LEONARD N.B.

ENERGY DEMONSTRATION PROJECT

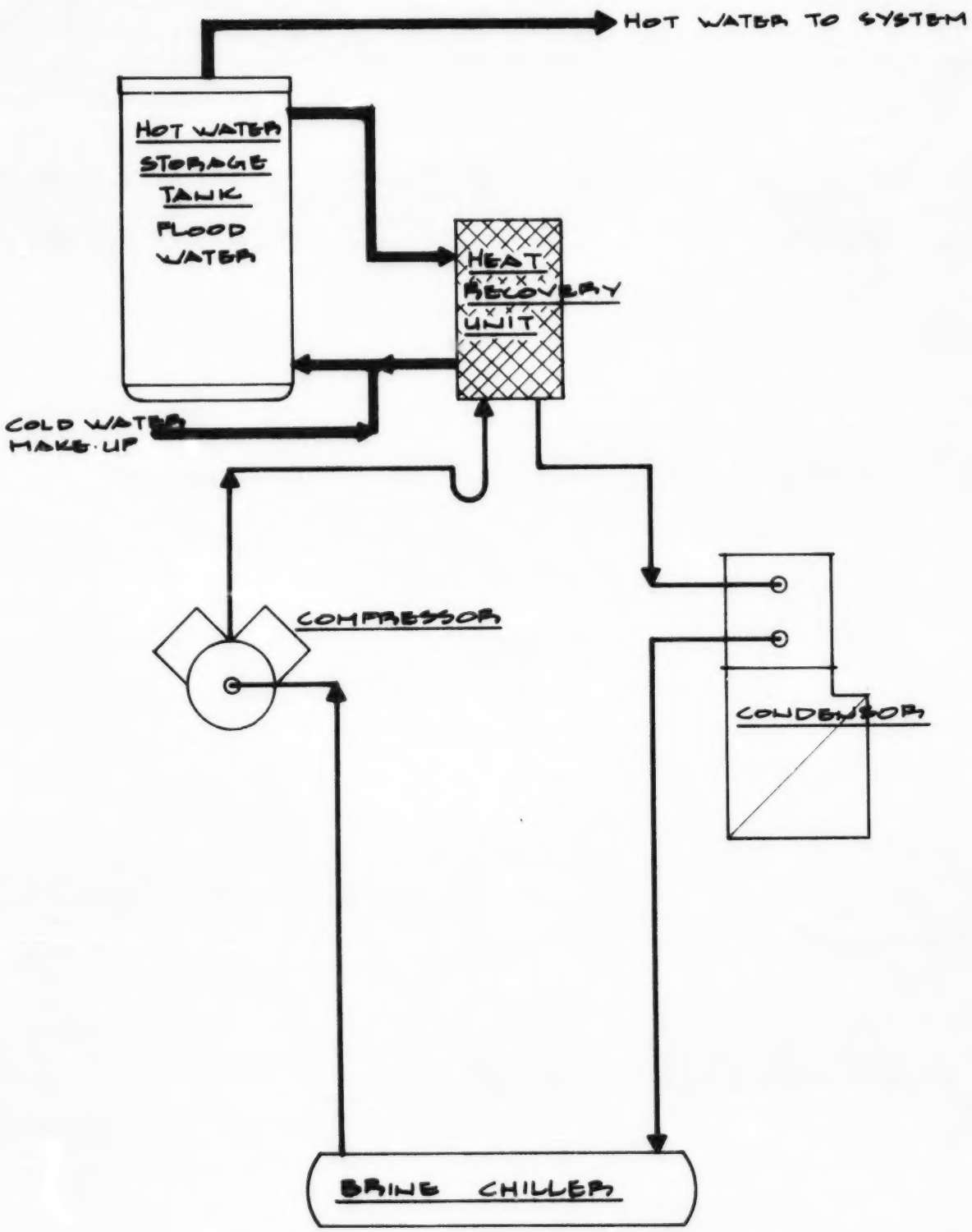
ENERPLAN CONSULTANTS LTD.
86 BOTSFORD STREET
MONCTON, N.B.

WEEK COMMENCING _____ 19 82		MON	TUES	WED	THUR	FRI	SAT	SUN	REMARKS
WATER METER	MAIN WATER METER	2132	2209	2291	2357	2436	2510	2595	
	FLOOD WATER	63	64	66	68	70	72	74	
	DOMESTIC HOT WATER	68	70	72	74	76	78	80	
ELECTRICAL METER (KWH) KWH / DEMAND	ICE SURFACE LIGHTNG	15 /	1551 / 320	1553 / 320	1555 / 320	1556 / 320	1559 / 310	1563 / 320	
	REFRIGERATION UNIT	0445 / 320	0449 / 340	0453 / 320	0458 / 330	0463 / 320	0468 / 340	0471 / 350	
	MISC. LOADS	1889 / 220	1891 / 220	1894 / 200	1897 / 220	1900 / 220	1903 / 220	1907 / 220	
ELAPSE TIME METERS (HOURS)	COMP. 1	853	61	869	878	86	894	900	
	COMP 2	990	996	998	1001	1006	1009	1013	
	BRINE PUMP	2256	2280	2308	2326	2350	2372	2399	
	COND. PUMP	552	555	561	569	577	585	591	
	COND. FAN	1129	1137	1146	1155	1164	1174	1182	
	DHW CIRC. PUMP	2104	2128	2152	2174	2198	2226	2247	
	WARM AIR BURNER	928	936	942	953	961	973	981	
	DHW BURNER METER	1783	1807	1828	1852	1874	1897	1923	
TEMPERATURES (°C)	INSIDE °C	-12 °C	-7 °C	-4 °C	-5 °C	-8 °C	-4 °C	0 °C	
	OUTSIDE °C	0 °C	-10 °C	5 °C	10 °C	0 °C	0 °C	0 °C	
BRINE TEMPERATURE (°C)									

APPENDIX C

SYSTEM SCHEMATIC

APPENDIX C - SYSTEM SCHEMATIC



TYPICAL REFRIGERATION SYSTEM
WITH HEAT RECLAIM

APPENDIX D

EFFICIENCY OF LIGHT SOURCES

APPENDIX D

EFFICIENCY OF LIGHT SOURCES

LIGHT SOURCE	LAMP WATTAGE	BALLAST WATTAGE	LUMENS	RATED LAMP LIFE	LUMENS/ WATT
Incandescent	300	-	6,000	1,000	20
	500	-	9,900	1,000	20
	1000	-	23,300	1,000	23
Flourescent	40 CW	8	3,150	20,000	65
	40 WW	8	3,200	20,000	66
	75 CW	15	6,300	12,000	70
Mercury	250	35	11,050	24,000	39
	400	50	20,880	24,000	46
Metal Halide	175	40	14,000	7,500	65
	400	50	34,000	15,000	76
High Pressure Sodium	100	16	9,500	20,000	82
	250	53	26,600	24,000	88
	400	75	50,000	24,000	105
Low Pressure Sodium	35	8	4,800	18,000	112
	90	18	13,500	18,000	125
	180	36	33,000	18,000	153